## C. K. Majumdar Memorial Lecture

The C K Majumdar Memorial Lectures are organized by the Satyendra Nath Bose National Centre for Basic Sciences, Kolkata as a tribute to Late Professor Chanchal Kumar Majumdar, the Founder-Director of the Centre.

### Past Speakers

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| **N Mukunda** | Geometric Phases for Two- and Three-Level Quantum Systems |
| **B Sriram Shastry** | Dynamical Symmetries, Accidental Degeneracies and Transport in Many Body Systems |
| **Sudhanshu S Jha** | Superconductivity in Solids: Misconceptions and Realities |
| **Guruswamy Rajasekaran** | Recent Discoveries in Neutrino Physics |
| **Jainendra K. Jain** | A new class of Fermions in Physics |
| **David Logan** | Optics and transport in heavy electron materials: theory meets experiment |
| **R Ramesh** | Whither Oxide Electronics? |

# 8th C. K. Majumdar Memorial Lecture

on

**NEW CONDENSATES OF MATTER AND LIGHT**

by


**Professor Peter Littlewood**

Cavendish Laboratory, University of Cambridge,
Cambridge, UK


on 5th January 2009 at 3.30 pm

at

Purbashree
Bharatiyam Multiplex, EZCC, Salt Lake

**S N Bose National Centre for Basic Sciences**

Kolkata

## ABSTRACT

# New condensates of matter and light


Macroscopic phase coherence is one of the most remarkable manifestations of quantum mechanics, yet it seems to be the inevitable ground state of interacting many-body systems. In the last two decades, the familiar examples of superfluid He and conventional superconductors have been joined by exotic and high temperature superconductors, ultra-cold atomic gases, both bosonic and fermionic, and recently systems of excitons, magnons, and exciton-photon superpositions called polaritons, the subject of this talk.

An exciton is the solid-state analogue of positronium, made up of an electron and a hole in a semiconductor, bound together by the Coulomb interaction. The idea that a dense system of electrons and holes would be unstable toward an excitonic (electrical) insulator is one of the key ideas underlying metal-insulator transition physics. The further possibility that an exciton fluid would be a Bose-Einstein condensate was raised over 40 years ago, and has been the subject of an extensive experimental search in a variety of condensed matter systems. Such a condensate would naturally exhibit phase coherence.

Lately, some novel experiments with planar optical microcavities make use of the mixing of excitons with photons to create a composite boson called a polaritons that has a very light mass, and is thus a good candidate for a high-temperature Bose condensate. Good evidence for spontaneous coherence has now been obtained1, though there are special issues to resolve2 considering the effects of low dimensionality, disorder, strong interactions, and especially strong decoherence associated with decay of the condensate into environmental photons3 --- since the condensate is a special kind of laser.



1. J. Kasprzak, et al.Nature, 443, 409-415 (2006).
2. J. Keeling, F. M. Marchetti, M. H. Szymanska, P. B. Littlewood, Semiconductor Science and Technology, 22, R1-26 (2007).
3. M. H. Szymanska, J. Keeling, P. B. Littlewood, Physical Review B 75, 195331 (2007)


## S. N. Bose National Centre for Basic Sciences

Block JD, Sector III, Salt Lake, Kolkata 700 098

On behalf of the Centre
I have great pleasure in inviting you to the
**8th C. K. Majumdar Memorial Lecture**
to be delivered by

**Professor Peter Littlewood**

Cavendish Laboratory, University of Cambridge,
Cambridge, UK

on

**New condensates of matter and light**

at

Purbashree
Bharatiyam Cultural Multiplex
Eastern Zonal Cultural Centre
IB-201, Sector III, Salt Lake, Kolkata 700 106

on

Monday, 5th January 2009 at 3.30 p.m.

followed by

High Tea (at 5.00 pm).

**Arup K Raychaudhuri**
Director